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**Comprehensive Remedial Investigation/Feasibility
Study for Argonne National Laboratory-West Operable
Unit 9-04 at the Idaho National Engineering and
Environmental Laboratory (FINAL)**

Volume I



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**Comprehensive Remedial Investigation/Feasibility
Study for Argonne National Laboratory-West Operable
Unit 9-04 at the Idaho National Engineering and
Environmental Laboratory (FINAL)**

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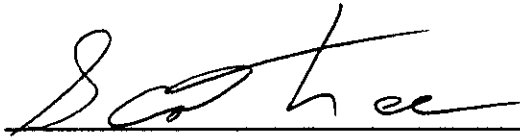
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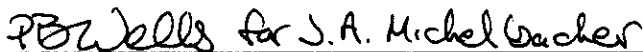
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EXECUTIVE SUMMARY

In November of 1989 the Idaho National Engineering and Environmental Laboratory (INEEL) was listed on the National Priorities List of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. In response to this listing, the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the State of Idaho negotiated a Federal Facility Agreement/Consent Order (FFA/CO) and Action Plan. This agreement described how the DOE, the EPA, and the State of Idaho would implement a remedial investigation/feasibility study (RI/FS) to characterize the nature and extent of the contamination and to evaluate the need to implement response actions.

Argonne National Laboratory-West (ANL-W) is included as Waste Area Group (WAG) 9 of the 10 INEEL WAGs identified in the FFA/CO. WAG 9 consists of 37 release sites, subdivided depending on the type of waste stream, into four Operable Units (OUs); 9-01, 9-02, 9-03, and 9-04. OU 9-04 is defined as the "WAG 9 Comprehensive RI/FS" in the FFA/CO. The RI/FS is designed to evaluate all release site characterization investigations conducted at WAG 9 to determine the cumulative and comprehensive risks posed to human health and the environment from past releases. The scope of the OU 9-04 RI/FS was defined in the *Work Plan for Operable Unit 9-04 Comprehensive RI/FS* (Lee et al., 1996).

Sites in the WAG 9 OUs are classified into the following categories: remedial investigation (RI) sites, interim action (IA) sites, Track 2 sites, Track 1 sites, "no action" sites, and new and unevaluated sites (i.e., those sites that were not listed in the FFA/CO). To date, ten Track 1 and two Track 2 investigations have been performed at WAG 9. An interim remedial action has been completed for OU 9-02 (ANL-08 Leach Pit). These previously submitted documents, together with new information gathered during the OU 9-04 RI, were used in the development of the baseline risk assessment (BRA) detailed in this document.

The objectives of the WAG 9 Comprehensive RI/FS are the following:

- To reevaluate all release sites listed in the FFA/CO to make sure waste processes were not overlooked
- To conduct a complete screening of all release sites and retain those release sites with contaminants of concern above INEEL background levels
- To determine or define the nature and the extent of contamination associated with each of the WAG 9 retained sites
- To determine the current and potential future cumulative and comprehensive risk to human health and the environment posed by WAG 9 retained sites.

In addition to the 37 sites that were identified in the FFA/CO for WAG 9, four potential sites and two OU 10-06 sites have also been included for evaluation in the OU 9-04 Comprehensive RI/FS. The wastes in these sites originated inside the ANL-W facility and are located within a mile of the ANL-W administrative boundary. By including them into the OU 9-04 Comprehensive RI/FS, the identification, disposal history, types of wastes present, and risks associated with the sites can be documented under the OU 9-04 record of decision.

To support the OU 9-04 RI/FS, sampling was conducted of the interbeds below the ANL-08 Leach Pit, and a new monitoring well was installed downgradient of ANL-01A Main Cooling Tower Blowdown Ditch in order to fill the data gaps identified in the OU 9-04 RI/FS Work Plan.

The BRA evaluated the potential adverse health effects on human and ecological receptors for both a current and future land-use scenario. The BRA considered risks associated with the “no action” alternative, and only evaluated contaminants that were released to the environment from past disposal practices and incidental releases.

The results of the BRA indicated that, of the 37 ANL-W release sites, only seven sites would be retained and evaluated under the OU 9-04 comprehensive RI/FS. The seven retained sites included one Track 1 site (ANL-61A), one Track 2 site (ANL-08), and five RI/FS sites (ANL-01A, ANL-01, ANL-09, ANL-35, and ANL-53). Four of these retained sites (ANL-08, ANL-01, ANL-09, and ANL-53) were subdivided into smaller, more manageable areas for the human health risk assessment based on the physical characteristics of the site. The BRA human health risk assessment results indicated that for the current and future occupational scenario, Cs-137 and Ra-226 would produce an unacceptable risk to humans at site ANL-01—Industrial Waste Pond. While the radionuclide, Cs-137 was the only contaminant to have an unacceptable risk for sites ANL-09—Canal and ANL-09—Mound. No contaminants exceeded the hazard index of 1 for either the current or future occupational exposure route.

For the potential 100- and 1,000-year future residential scenario, carcinogenic risks were unacceptable for the 100-year external radiation exposure at ANL-01—Industrial Waste Pond for Cs-137 and Ra-226 and for release site ANL-09—Mound for Cs-137. Release site ANL-61A produced unacceptable risks at 100- and 1,000-years for ingestion of soil and ingestion of homegrown produce exposure pathways because of the PCB-contaminated soil. The PCB contaminated soil was removed in the summer of 1997 and a summary is included in Appendix L of this report. While the external radiation exposure at ANL-01—Industrial Waste Pond shows an unacceptable risk for Ra-226 for the 1,000-year future residential scenario. In addition the cumulative exposure from all release sites for the 100- and 1,000-year future residential scenario produced unacceptable risks for the ingestion of groundwater and inhalation of vapors from indoor water use exposure pathways because of high levels of arsenic in the soil.

ANL-W has no unacceptable hazard indices for the current or future occupational exposure scenarios. But, for the potential 100- and 1,000-year

future resident, the hazard index of 1 was exceeded for the ingestion of soil pathway at ANL-01—Industrial Waste Pond, ingestion of homegrown produce at three sites (ANL-01A—MCTBD, ANL-01—Industrial Waste Pond, and ANL-01—Ditch B), and for the cumulatively (all sites) calculated ingestion of groundwater pathway. The contaminants which accounted for these high hazard indices are arsenic and hexavalent chromium for the ingestion of soil pathway, mercury and zinc for the ingestion of homegrown produce pathway, and arsenic and fluoride for the cumulatively determined ingestion of groundwater pathway.

The results of the WAG 9 ERA indicate that of the 37 ANL-W release sites, eight (ANL-01, ANL-01A ANL-04, ANL-05, ANL-09, ANL-29, ANL-35, and ANL-36) produce potentially unacceptable risks for ecological receptors due to metals. One site ANL-35 also had unacceptable risks for ecological receptors due to organics. Five of these sites (ANL-01, ANL-01A ANL-04, ANL-09, and ANL-35) have been retained for further evaluation in the feasibility study. Three sites (ANL-05, ANL-29, and ANL-36) were screened from inclusion in the feasibility study in Section 7. These three sites only contained one inorganic within acceptable limits for each site.

The feasibility study evaluated the release sites that were identified in the BRA and ERA and pose unacceptable risks to human health and the environment. The feasibility study identified five remedial alternatives and evaluated each on their ability to reduce the risk to human health and the environment by eliminating the exposure pathway or reducing the source of the risk. Of the five alternatives three were retained and extensively evaluated using the nine CERCLA criteria. Two alternatives were screened because they did not meet the remedial action objectives by eliminating the exposure pathway or reducing the source. DOE, along with the regulators (IDHW and EPA) will evaluate the remaining alternatives and select the preferred alternative for use at WAG 9. This preferred alternative will then be presented to the public and any comments that are received will be reviewed and incorporated when appropriate. The selected remedial action alternative will then be chosen and implemented at ANL-W.

One of the release sites (ANL-01A—MCTBD) being investigated in the RI/FS was originally designated as a Land Disposal Unit (LDU) under the COCA agreement. This site was designated as a LDU because of the release of a caustic material that occurred after November, 1980. Because this site retained its LDU designation, special requirements were established in the FFA/CO Agreement for its cleanup. A conference call with IDHW/DEW was held on October 3, 1997 to determine the RCRA/CERCLA integration for the ANL-01A—MCTBD. It was determined that the MCTBD is a RCRA LDU and will be remediated under the CERCLA process in accordance with the applicable substantive requirements of RCRA/HWMA, if an unacceptable risk to human health or the environment is demonstrated. However, the Federal Facility Agreement and Consent Order (FFA/CO) has only adopted RCRA corrective action [3004 (u) & (v)], and not RCRA/HWMA closure. Therefore, upon completion of the remedial action, the DOE-CH must receive approval from the IDHW/DEQ director that the MCTBD has been closed pursuant to RCRA/HWMA closure requirements.

This document presents the results of the RI/FS phase of the OU 9-04 Comprehensive RI/FS. Background information that has been conducted prior to this RI/FS phase is presented in Section 1. A discussion of the INEEL and ANL-W's geographical setting, operational history, and physical characteristics is provided in Section 2. The risk management considerations identified from the performance of the OU 9-04 BRA are based on the site and contaminant screening evaluations, nature and extent of contaminant evaluations, and the human health risk assessment described in Sections 3 through 5, respectively. Section 6 presents the risks to the ecological receptors. While, Section 7 develops of remedial action objectives and general response actions. The development of remedial alternatives is shown in Section 8. The screening of the alternatives in Section 9, and finally the detailed analysis of alternatives in Section 10. Section 11 presents summaries and conclusions of the OU 9-04 RI/FS.

Appendices A through M contain OU 9-04 site characterization analytical data and other information to support the human health and ecological risk evaluations.

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ACRONYMS/ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
AF	adjustment factor
ANL-W	Argonne National Laboratory-West
ANL-09	Interceptor Canal
ANP	Aircraft Nuclear Propulsion
ALARA	as low as reasonably achievable
AMWTF	Advanced Mixed Waste Treatment Facility
ARAR	applicable or relevant and appropriate requirement
BAF	bioaccumulation factor
B(a)P	benzo(a)pyrene
bgs	below ground surface
BLM	Bureau of Land Management
BLS	below land surface
BRA	Baseline Risk Assessment
C2	Category 2
CDC	Conservation Data Center
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	concentration factor
CFA	Central Facilities Area

CLP	Contract Laboratory Program
CMP	corrugated metal pipe
COCs	Contaminants of Concern
COCA	Consent Order and Compliance Agreement
COLIWASA	composite liquid waste sampler
COPC	contaminant of potential concern
CRAVE	Carcinogen Risk Assessment Verification Endeavor
CRDL	contract required detection limits
CRQL	contract-required quantification limit
CSM	conceptual site model
D&D	decontamination and decommissioning
DEHP	Bis2-ethylhexylphthalate
DOD	Department of Defense
DOE	Department of Energy
DOE-CH	Department of Energy-Chicago Operations Office
DOE-ID	Department of Energy-Idaho Operations Office
DQO	data quality objective
EBR-II	Experimental Breeder Reactor II
EBSL	ecologically based screening level
ECAO	Environmental Criteria and Assessment Office
ED	exposure duration
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERA	ecological risk assessment
ERIS	Environmental Restoration Information System

ESRP	Eastern Snake River Plain
FCF	Fuel Conditioning Facility
FMF	Fuel Manufacturing Facility
FS	Feasibility Study
FSP	Field Sampling Plan
FFA/CO	Federal Facility Agreement and Consent Order
FR	Federal Register
FFA/CO	Federal Facilities Agreement/Consent Order
G&A	general and administrative
GI	gastrointestinal
GIS	Geographic Information System
gpm	30 gallons per minute
GRA	general response actions
ha	hectare
HEAST	Health Effects Assessment Summary Tables
HFEF/N	Hot Fuel Examination Facility/North
HFEF/S	Hot Fuel Examination Facility/South
HEPA	high efficiency particulate air filter
HI	hazard index
HpCDD	heptachlorinated dibenzodioxin
HpCDF	heptachlorinated dibenzofuran
HxCDD	hexachlorinated dibenzodioxin
HxCDF	hexachlorinated dibenzofuran
HQ	hazard quotient
IDAPA	Idaho rules for prevention of significant deterioration of air quality

IDHW	Idaho Department of Health and Welfare
IFR	Integral Fast Reactor
INEL	Idaho National Engineering Laboratory
INEEL	Idaho National Engineering and Environmental Laboratory
INPS	Idaho Native Plant Society
IR	ingestion rate
IRIS	Integrated Risk Information System
IWP	Industrial Waste Pond
ICPP	Idaho Chemical Processing Plant
keV	kiloelectron volt
LDR	Land Disposal Restrictions
LDU	Land Disposal Unit
LLW	low level waste
L&O	Laboratory and Office Building
LOAEL	lowest observed adverse effect level
L&V	Limitation and Validation
MCLs	maximum contaminant levels
MCTBD	Main Cooling Tower Blowdown Ditch
MEK	methyl ethyl ketone
MeV	megaelectron volts
MF	modifying factor
mg/y	million gallons per year
MS	matrix spike
MSD	matrix spike duplicate
MSL	mean sea level

NEPSHAP	National Emissions Standards for Hazardous Air Pollutants
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRTS	National Reactor Testing Station
O&M	operations and maintenance
OCDD	octachlorinated dibenzodioxin
OCDF	octachlorinated dibenzofuran
OU	Operable Unit
PAHs	polyaromatic hydrocarbons
PCB	Polychlorinated Biphenyl
PeCDD	pentachlorinated dibenzodioxin
PeCDF	pentachlorinated dibenzofuran
PPE	personnel protective equipment
PUF	plant uptake factor
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objectives
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act

RD	remedial design
RD/RA	remedial design/remedial action
RESL	Radiological and Environmental Sciences Laboratory
RfC	reference concentration
RfD	reference dose
RI	Remedial Investigation
RI/BRA	Remedial Investigation/Baseline Risk Assessment
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximum exposure
RML	Radiological Measurement Laboratory
RPMs	remedial project managers
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
SAP	Sampling and Analysis Plan
SDGA	screening and data gap analysis
SF	slope factor
SL-1	Stationary Low Power Reactor-1
SLERA	screening level ecological risk assessment
SMC	Specific Manufacturing Capability
SMO	Sample Management Office
SQLs	sample quantitation limits
SNAPTRAN	System for Nuclear Auxiliary Power Transients Program
SOP	standard operating procedure
SRP	Snake River Plain
SRPA	Snake River Plain Aquifer

SUF	site use factor
SVOC	semivolatile organic compound
TAP	toxic air pollutants
TBC	to-be-considered
TCDD	tetrachlorinated dibenzodioxin
TCDF	tetrachlorinated dibenzofuran
T/E	threatened or endangered
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TIC	tentatively identified compound
T-RACT	toxic air pollutants reasonable available control technologies
TRV	toxicity reference values
TSCA	Toxic Substances Control Act
TREAT	Transient Reactor Test Facility
UCL	upper confidence level
UF	uncertainty factor
UMTRA	uranium mill tailings remedial action
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geologic Survey
UST	underground storage tank
UTL	upper tolerance level
VOA	volatile organic analysis
VOC	volatile organic compound
WAC	waste acceptance criteria
WAG	Waste Area Group

WERA WAG ecological risk assessment

ZPPR Zero Power Physics Reactor

